

### **3.3 OCEANOGRAPHY/COASTAL PROCESSES**

Beaches are dynamic environments subject to seasonal and annual movement of sand offshore and onshore, as well as alongshore within a generally defined littoral cell. Modification of structures or water body connections to the coast (e.g., lagoon inlets) can also influence sand movement, or transport, in a littoral cell.

This section is based largely on information from the SELRP Shoreline Morphology Report (M&N 2012a) and the Coastal Regional Sediment Management Plan (SANDAG 2009). For that report, available literature was reviewed to determine existing conditions within the project area to analyze the fate of the beach fills. The *Coast of California Storm and Tidal Wave Study, San Diego Region* was a major source of data on coastal conditions, including waves, the sediment budget, and longshore sediment transport data (Corps 1990, 1991). Other studies include a 1994 Shoreline Erosion Assessment and Atlas of the San Diego Region (California Department of Boating and Waterways and SANDAG 1994, referred to herein as DBW/SANDAG 1994) and a study of littoral cells and sand budgets in California (Patsch and Griggs 2006, 2007). Information from the 2012 RBSP EIR/EA is also incorporated, as appropriate.

The function of a complex system like a lagoon is not easily captured in the template of an EIR/EIS. Accordingly, Section 3.2 (Hydrology) and Section 3.4 (Water and Aquatic Sediment Quality) address tidal dynamics within the lagoon, as well as tidal exchange between the lagoon and ocean in the context of water quality. Section 3.4 also addresses water quality within the ocean as it relates to placement of disposal/reuse materials. Section 3.6 (Biological Resources) addresses potential biological impacts associated with the dispersion of sand placed as part of materials disposal/reuse. Long-term sea level rise and potential extreme events associated with climate change are discussed in Section 3.16 (Global Climate Change and Greenhouse Gas Emissions) of this document.

#### **3.3.1 AFFECTED ENVIRONMENT**

This discussion is focused on the Oceanside Littoral Cell, which encompasses San Elijo Lagoon and the onshore and nearshore materials placement sites, and is adjacent to offshore stockpiling sites. Specific conditions at San Elijo Lagoon and the proposed materials disposal/reuse sites follow the broader overview of coastal geomorphology.

#### **Coastal Geomorphology**

The project study area extends from the City of Encinitas south to the northern end of the City of San Diego, within San Diego County. The coastal area in this portion of the County is

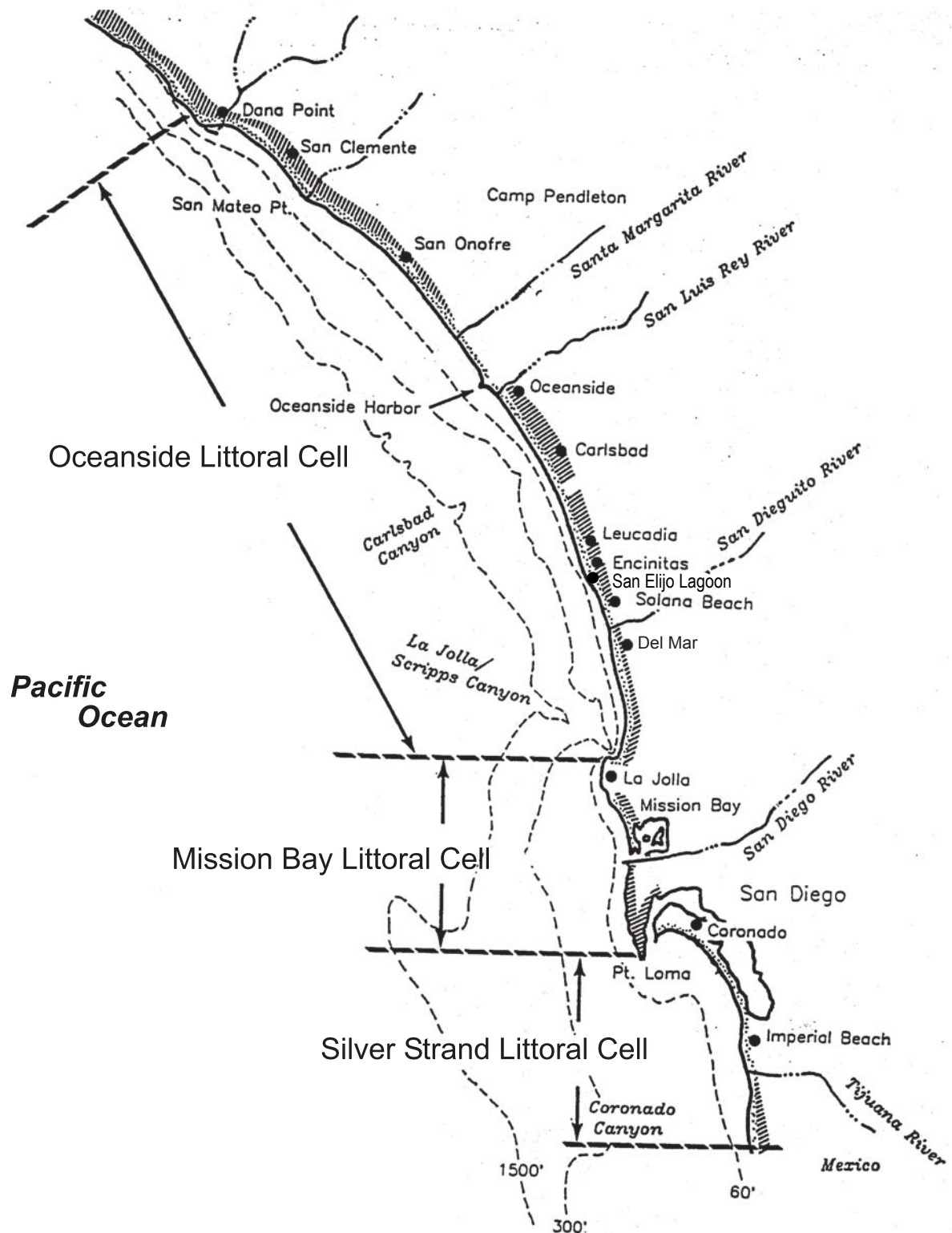
characterized by sandy/cobble beaches that vary in width and sand cover both seasonally and annually. The study area is located entirely within or adjacent to the Oceanside Littoral Cell, with the exception of LA-5, which is located approximately 30 miles south, 6 miles offshore of the Mission Bay Littoral Cell. The southern half of the Oceanside Littoral Cell stretches from Oceanside to La Jolla<sup>3</sup> and includes the shorelines of the cities of Oceanside, Carlsbad, Encinitas, Solana Beach, Del Mar, and La Jolla, and encompasses the project study area. The littoral cells located in San Diego County are illustrated in Figure 3.3-1.

A littoral cell is a coastal reach bounded by physiographic features (e.g., submarine canyons, coastal headlands, harbors, etc.) where sediment enters, moves along, and leaves the coast. The littoral cell is a segment of coastline that does not naturally transport or receive littoral sediment to or from another cell in either the “upcoast” or “downcoast” direction (Corps 1991). However, within the cell, a complete cycle of sedimentation exists that can include erosion of highland terrain, fluvial transport to the shoreline, and littoral transport along the shoreline. Once sediment is entrained in the littoral transport system, it can be lost from that system by cross-shore transport offshore or by channeling it into a deep basin via a submarine canyon. Sediment sources to a cell include beaches, rivers, bluffs, offshore deposits, bypassing, and artificial nourishment. Sediment sinks are submarine canyons, offshore deeper-water areas, inland lagoons, and harbors. Beaches and the nearshore zone represent storage areas within a littoral cell. The sediment budget is either in balance with stable beaches, in a surplus with growing beaches, or in a deficit with narrowing beaches. The portion of the Oceanside Littoral Cell encompassing the project study area is in a deficit of nearly 55,000 cubic yards per year (cy/yr), as evidenced by widespread beach retreat since the early 1980s (DBW/SANDAG 1994) into the present (Patsch and Griggs 2006, 2007).

Bounded on one side by the landward limit of the beach and extending seaward beyond the area of breaking waves, the seaward edge of an active littoral cell is defined as its depth of closure. Substantial quantities of sand from coastal littoral cells do not usually travel outside of this depth and into the deeper ocean in large quantities, except during severe coastal storm wave events. Typically in the San Diego region, greater sand movement from the shallow portion of the beach profile to the deeper portion of the profile within the littoral zone occurs in the winter due to large storms and waves, followed by a period of sand gain to the shallow portion of the beach profile during the summer’s more gentle conditions and surf. Thus, the exposed portion of the beach is generally wider in the summer and narrower in the winter. These combined seasonal processes, including both winter and summer sand shifts, compose a complete cross-shore sedimentation cycle. Longshore sand transport occurs continually and also varies seasonally. Insufficient shoreward energy generally exists to move sand from outside the depth of closure back into the

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<sup>3</sup> The northern half of the Oceanside Littoral Cell extends from Oceanside to Dana Point in Orange County.



Source: Moffatt & Nichol Engineers

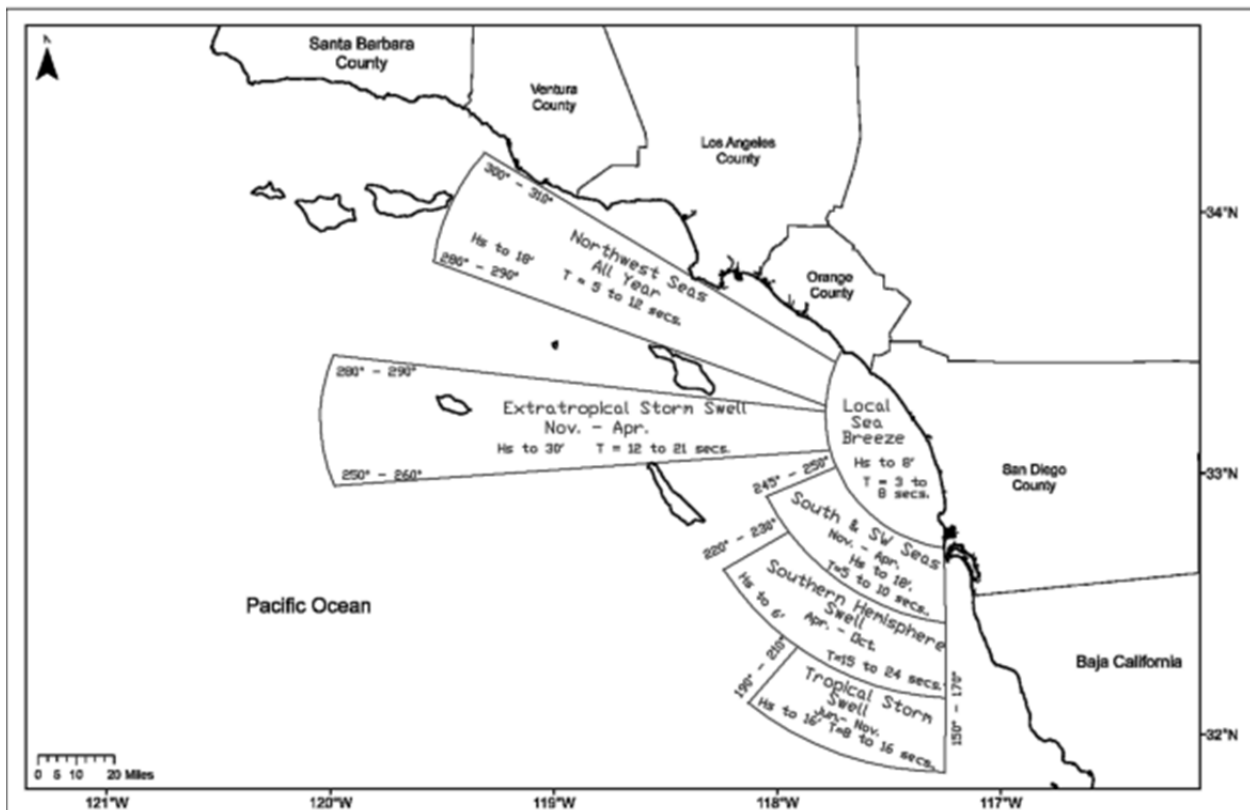


**Figure 3.3-1**  
**Littoral Cells in the San Diego Region**

littoral cell. Sand located or carried outside of the depth of closure essentially exits the littoral cell and is no longer available to naturally replenish beaches during the summer. In San Diego, the depth of closure ranges from approximately -13 to -32 feet mean sea level (msl) (Coastal Frontiers 2010b). The proposed offshore stockpile areas of SO-5 and SO-6 are located outside (deeper than) the depth of closure and therefore do not have measurable exchange with the nearshore/beach sand volumes.

Net sediment transport within the Oceanside Littoral Cell occurs to the south (Corps 1991), with minor seasonal reversals in the dominant sediment transport direction that can extend over longer periods of years. Summer and fall seasons are typically dominated by southern hemisphere swells that generate currents and sediment transport to the north. Winter and spring seasons are typically dominated by northern hemisphere swells that generate currents and sediment transport to the south. The wave exposure window at San Elijo Lagoon is shown in Figure 3.3-2. This winter/spring condition is typified by higher energy waves than summer/fall conditions and so the southern transport tends to be the dominant process over the long term.

**Figure 3.3-2**  
**Wave Exposure Window of San Elijo Lagoon**



Site-specific conditions in the vicinity of San Elijo Lagoon show a higher-than-average occurrence of reversals of the longshore transport and direction due to local bathymetry and wave refraction at Cardiff reef (Coastal Environments 2001). As a result, the net longshore sediment transport rate is reduced in the vicinity of the existing inlet. High volumes of cobble are also contained in the littoral zone adjacent to San Elijo Lagoon. Other site-specific conditions relate to the location of the existing inlet and Coast Highway 101 along the west edge of the lagoon, protecting the interior of the lagoon from intensive wave action during storm events and in the event of tsunami.

### **San Elijo Lagoon Study Area**

The inlet at San Elijo Lagoon is constrained in its location by the existing Coast Highway 101 crossing, then by the railroad trestle located southeast of the inlet. The resulting channel extending east from the inlet is sinuous as it passes under those two infrastructure crossings, and water velocities exiting the lagoon are not sufficient to counteract the offshore longshore sand transport to maintain a stable, open connection with the ocean. There is a rock sill located just offshore under the beach (approximately 4 feet NGVD) at the Coast Highway 101 crossing, which further constrains the ability of the inlet to maintain an open condition once manually opened.

The inlet is bounded on the north by a small bluff, with an occasional front-beach extending south of the bluff into the channel. South of the inlet, the sandy beach is characterized by varying widths and is backed by a parking lot. Sand dredged from the lagoon inlet during manual maintenance/opening is placed on the beach south of the inlet mouth as part of the sand bypassing process, and results in generally wider beaches for a period after maintenance occurs.

### **Ebb Bar Development**

Longshore transport of sand within a littoral cell results in a “river of sand” moving parallel to the shoreline. As this “river” crosses river and lagoon mouths that are open to tidal action, the cross-current action of an outgoing or incoming tide deflects material from its parallel movement. This leads to sand bar formation either out into deeper water (ebb bar) or into the water body itself (flood shoal).

At San Elijo Lagoon, tidal hydrodynamics and ocean waves lead to both sand bar formation off the lagoon mouth in an ebb bar and within the lagoon in a flood shoal. Ebb bars can cause changes to incoming ocean waves and consequent changes to the shoreline. Flood shoals can mute tides in a lagoon and result in changes to hydrology affecting habitat and water quality. This section addresses the existing ebb bar located adjacent to the San Elijo Lagoon inlet and ebb

bars that may develop as part of project implementation. Section 3.2 (Hydrology) addresses flood shoal development within the lagoon in the context of hydrology.

The existing ebb bar at San Elijo Lagoon is estimated to be located relatively close to the inlet (at -10 feet NGVD) and contain approximately 3,600 cy of sand (M&N 2012a). Waves typically limit ebb bar growth by resuspending and transporting sediment either into the inlet (i.e., to build the flood shoal) or to the downdrift beach (i.e., bypassing the inlet). The flood shoal is estimated to contain approximately 63,300 cy of material, resulting in a relatively unstable inlet due to a system that is clearly flood-dominated (e.g., more material is entrained into the lagoon inlet than is scoured from the lagoon and inlet by ebb tides).

#### Inundation Conditions

The interior of the lagoon and structures along its perimeter are currently protected from high wave energy along the beaches during coastal storm wave events. The west and central basins of the lagoon are mapped within the tsunami inundation area by the California Emergency Management Agency (2009). The combined protective effects of a nearly continuous high earthen dike supporting Coast Highway 101 along the entire west boundary of the lagoon, and the relatively narrow tidal inlet mouth and long sinuous inlet channel, shield the lagoon from much of the wave energy associated with large coastal storm wave events.

#### **Materials Disposal/Reuse Study Area**

##### LA-5

LA-5 is located outside of the littoral zone, in approximately 480 to 650 feet of water. The depth of the site results in a relatively undisturbed bottom, regardless of the more surficial current and wave patterns. As a result, it is only slightly affected by the processes that result in sediment transport in the littoral zone.

##### SO-5/SO-6

SO-5 and SO-6 are outside of the depth of closure in approximately 35 to 56 feet of water. While there may be some sediment movement within and adjacent to the sites, particularly during severe storm events when wave energy is high enough to move sand from the beach/nearshore past the depth of closure, this transport volume is very low. Surveys conducted at SO-5 between 2000 and 2009 indicated that after dredging conducted for 2001 RBSP, the borrow site had accumulated approximately 1 foot of material, but the bathymetric changes remained identifiable 8 years after the material was removed. The bathymetric difference between the borrow sites and

adjacent areas is likely to continue in the foreseeable future because the material that would fill the dredge area results from infrequent, powerful storm events (SANDAG 2011).

#### Beaches and Nearshore

Coastal processes that drive beach conditions within the southern portion of the Oceanside Littoral Cell are generally common to the proposed nearshore and onshore sand placement sites. Leucadia and most of Solana Beach are primarily narrow beaches backed by bluffs that are frequently subjected to direct wave energy. Moonlight, Cardiff, and Torrey Pines beaches, as well as a segment of Solana Beach directly adjacent to Fletcher Cover, are generally slightly wider beaches, with some bluff and/or reef protection that helps support the creation of pocket beaches. In addition, some of these beaches, including Moonlight, Cardiff, and Torrey Pines, benefit from consistent nourishment through either opportunistic placement (Moonlight) or lagoon bypassing, in which sand entrained in lagoons is removed and placed on adjacent beaches downcoast to enable the sand to continue to follow longshore drift patterns (Cardiff and Torrey Pines). While an existing ebb bar is located off of the San Elijo Lagoon inlet, it is relatively small and close to shore, potentially constrained by Cardiff Reef located farther offshore.

#### Coastal Lagoons/Wetlands

Sand moving alongshore can become trapped behind coastal structures and inlets, leaving less sand downcoast for transport, and potentially creating a flood shoal that can close the mouth, with adverse impacts to the system. Regular maintenance at structures and lagoons minimizes water body closure/constriction at ocean interfaces and replenishes downcoast beaches by bypassing trapped sand. A series of open lagoon mouths exists along the San Diego County coast. There are three lagoons in proximity to the beaches where material dredged from San Elijo Lagoon may be placed for beneficial reuse. These lagoons are:

- Batiquitos Lagoon – This lagoon was restored between 1994 and 1997, with stabilization of the entrance with jetties and dredging of approximately 2 mcy of sand from the wetlands. The ocean inlet remains open continuously and is subject to sedimentation under existing conditions. Maintenance dredging is performed periodically by CDFW, according to available funding and permits, with sand placed mainly south of the entrance channel.
- San Dieguito Lagoon – The lagoon was restored by 2009. The mouth is not stabilized by jetties; it is scheduled for annual excavation of sand by Southern California Edison with placement on the beach on both sides of the entrance channel.

- Los Peñasquitos Lagoon – This lagoon mouth is not stabilized by jetties and is subject to closure due to its relatively small tidal prism and frequent blockage by sand and cobbles; it is annually excavated of sand by the Los Peñasquitos Lagoon Conservancy with placement on the beach south of the entrance channel. The amount of excavated material varies up to 35,000 cy (Hastings 2010).

Buena Vista and Agua Hedionda lagoons are too far north from the project area to be potentially affected by sand transport from the beneficial reuse, and therefore are not discussed further.

### **3.3.2 CEQA THRESHOLDS OF SIGNIFICANCE**

A significant impact related to oceanography/coastal processes would occur if implementation of the proposed project would substantially:

- A. Increase the erosion rate of beach sediment resulting in long-term loss to area beaches downcoast from the lagoon;
- B. Disrupt the littoral system due to changes in inlet configuration, ebb bar prefilling, maintenance dredging, or sand placement for disposal/reuse;
- C. Increase risks of damage to coastal structures, including inundation by wave refraction seiche, tsunami, or mudflow; or
- D. Increase the volume of area lagoon sedimentation from sand accretion to a level that results in additional maintenance frequency (not removal of larger volumes) compared to historic requirements. This threshold is considered in relation to material reuse only.

The CEQA thresholds of significance for coastal processes were derived from a combination of thresholds listed in Appendix G of the CEQA Guidelines and thresholds used in the EIR/EIS for the San Dieguito Wetland Restoration Project (SCH #98061010) and the 2012 RBSP EA/EIR (SCH #2020051063).

### **3.3.3 ENVIRONMENTAL CONSEQUENCES**

This section discusses the environmental consequences, or impacts, associated with the proposed project related to oceanography/coastal processes. Potential adverse, significant, or beneficial direct and indirect impacts are identified as appropriate.

Numerical modeling was used to simulate changes in shoreline morphology from the SELRP project. The project was modeled with the Coastal Engineering Design and Analysis System



(CEDAS), which uses a numerical model called GENESIS as a base program for shoreline movement modeling by predicting longshore sediment transport. GENESIS is intended to provide a generalized long-term trend in shoreline response from a specific action or actions. Numerical modeling of shoreline morphology is inherently imperfect because of the complexity of coastal processes. There is no comprehensive numerical model that accounts for the natural processes of coupled longshore and cross-shore sediment transport. To address cross-shore transport for this project, a subsequent beach profile analysis was conducted to convert GENESIS shoreline results into sand thicknesses (depth of sand cover) from project alternatives at specific locations within the project study area. The results anticipate general areas of accretion or erosion rather than predict site-specific increments of shoreline movement over time. In addition, modeling was conducted to estimate ebb and shoal bar development at San Elijo Lagoon under each of the proposed alternatives (M&N 2012a).

Coastal wetlands have the potential to be affected by materials placement within the littoral zone, so that discussion is only included under the Materials Disposal/Reuse analysis.

## **Lagoon Restoration**

### ***Alternative 2A–Proposed Project***

Construction of a new tidal inlet to San Elijo Lagoon has the potential to change the way in which sand and waves act in proximity to the lagoon. Generally, sand deposited in an ebb bar or flood shoal is removed from littoral drift (at least temporarily, until a flood shoal is bypassed through inlet management) and does not settle on adjacent beaches or in the littoral zone. If the inlet changes substantially enough to modify volumes stored in an ebb bar, sand could be removed from Cardiff Beach to create that bar unless sand is provided by another source. The proposed project would have a larger inlet at a new location. This new ebb bar is predicted to have a volume of approximately 345,000 cy at equilibrium. This is a substantial increase from the existing ebb bar of 3,600 cy at the current inlet.

The ebb bar would be larger than the volume of the flood bar (266,000 cy) and the new inlet would result in a more tidally stable ebb-dominated system. The project would “prefill” the ebb bar through the proposed nearshore and onshore placement of material at Cardiff State Beach. This approach is similar to that taken at other coastal lagoon restoration projects (e.g., Bolsa Chica Lowlands Restoration Project). Preenriching the littoral cell in the vicinity of the site during construction with sufficient sand to offset the total quantities of sand stored in the bars would minimize the effect of the new inlet configuration on beach sand erosion and would result in less than significant effects to beach erosion. Lagoon maintenance dredging and placement of that material downcoast would effectively return that sand to the littoral zone. This **bypassing**

**would offset the effects of sand storage in the flood bar and would result in less than significant impacts to beach erosion downcoast (Criterion A). No substantial adverse impacts would occur to downcoast beach erosion.**

Sand placement to pre-nourish the littoral zone onshore at Cardiff would not change the bathymetry of the bottom substantially enough to modify wave patterns, water currents, or sand transport pattern. However, installation of an ebb bar would change bathymetry and wave patterns over a relatively small area of the littoral cell and could provide a surfing benefit. These localized effects are discussed further in Section 3.1 (Land Use). Coastal sediment transport systems operate on a large scale and are dominated by wave climate and sediment supply, and the relatively small ebb bar form created off Cardiff is not sufficiently large to modify large-scale coastal currents and sediment transport. Several similar bars have been installed or have formed naturally off other lagoons (i.e., Batiquitos Lagoon, Bolsa Chica, and Huntington Beach Wetlands) and have resulted in relatively small-scale changes to wave breaking patterns, but not large-scale changes to wave-driven current patterns and sediment transport (M&N 2013). Therefore, no changes to littoral processes from the SELRP are anticipated, and **no substantial adverse impacts to the littoral system would occur. Impacts would remain less than significant (Criterion B).**

Sand placement on the beach and in the nearshore is anticipated to result in a wider beach in front of the proposed inlet and along the remainder of Cardiff State Beach on a temporary basis. The proposed project would construct a new inlet with CBFs to enhance inlet stability, and would raise Coast Highway 101 to an elevation that would provide adequate clearance. The raised roadway would be protected on the ocean side with riprap (as presently exists) and designed to resist damage due to extreme storm events (PDF-30 and PDF-31), as required. NCTD is also proposing to raise the existing railroad trestle to accommodate additional flows as part of the double-tracking project, and to potentially allow a dredge to pass beneath the new bridge while performing maintenance dredging.

Ocean waves would propagate through the new tidal inlet and into the lagoon. This process would occur typically at higher tides and/or during high wave events. The CBFs would serve to reduce incoming wave energy by blocking a portion of incident wave energy at the inlet mouth. Wave properties change as they pass from the ocean through the constrained inlet channel and then into the west and central basins. Waves typically diverge, or “fan-out,” as they enter the inlet channel, and then conserve much of their energy while in the channel. Wave divergence results in loss of energy and height from their original ocean condition as they move inland. Waves also lose energy to friction with the inlet bed and banks as they continue to move upstream. Waves would reach the west basin and then diverge further and spread out toward the broader basin boundaries, continuing to diverge as they move toward the central basin. The

shape of the west and central basins is intentionally designed as one large oval to maximize wave divergence and energy loss. Waves tend to focus on protrusions into basins and this can cause erosion, so the project design has no protrusions in the basins. As such, ocean waves would become substantially smaller and less energetic as they pass into the basin(s) and should not result in significant erosion. There is a chance that the mudflat area east of the full tidal basin in the central basin may experience some small-scale erosion under certain conditions, but that process would only be anticipated to result in shifting of sediment into another portion of the basin, creating similar habitat, so no net loss of habitat is expected **and significant impacts to coastal structures from inundation through wave refraction would not occur (Criterion C). No substantial adverse impacts are anticipated.**

In the event of tsunami, additional areas of inundation are not anticipated to occur. Tsunami inundation under Alternative 2A should be the same as for existing conditions, as the wavelength is so long that the relative lengths of both tidal inlet channels would not substantially dampen the water level increase. The greater risk posed by tsunamis is the high velocity of the return flow from the lagoon back to the sea. Scour of bridge piles and abutments occurs from extremely high ebb flows. The new bridges at the railroad and at Coast Highway 101 under Alternative 2B would possess deep pile foundations and well-protected abutments (PDF-31), thus protecting them adequately from scour associated with tsunamis. SANDAG prepared a sea level rise study (SANDAG 2013) for the region with recommendations on pile foundations and abutment protection for bridges spanning County wetlands. These design recommendations would be included in the proposed project bridges (PDF-30). No increased risk of inundation of coastal structures would result from project implementation.

While the raised Coast Highway 101 and railroad bridges would enable additional flow to enter the lagoon, coastal structures within the lagoon are located on the perimeter or farther east, where additional exposure to inundation would not be substantial. Immediately along the beach, the addition of sand would temporarily provide additional protection to businesses along Coast Highway 101, including Restaurant Row. **No substantial adverse or significant impacts would result with respect to risks of damage to coastal structures (Criterion C).**

### ***Alternative 1B***

Alternative 1B would result in an ebb bar at the existing location with a volume of approximately 6,500 cy at equilibrium, increased from the existing 3,600 cy. The flood bar would remain substantially larger than the volume of the ebb bar (up to 93,000 cy if there is no inlet maintenance, but approximately 41,000 cy if maintained annually) under Alternative 1B, and the inlet would remain flood dominated, as it is under existing conditions. The project would account for the relatively small increase in nearshore storage needs in the ebb bar through the proposed

nearshore and onshore placement of material at Cardiff State Beach. Prenourishing the littoral cell in the vicinity of the site during construction with sufficient sand to offset the total quantities of sand stored in the bars would minimize the effect of the modified inlet conditions on beach conditions and would result in less than significant impacts to beach erosion. As with Alternative 2A, lagoon maintenance activities and placement of that material downcoast would effectively return that sand to the littoral zone. **This bypassing would offset the effects of sand storage in the flood bar and no substantial adverse impacts would occur. There would be less than significant impacts to beach erosion downcoast (Criterion A).**

As discussed under Alternative 2A, sand placement to prenourish the littoral zone within the nearshore and onshore at Cardiff would not change the bathymetry of the bottom substantially enough to modify wave patterns, water currents, or sand transport patterns. **Therefore, no changes to littoral processes from the SELRP are anticipated, and no substantial adverse or significant impacts to the littoral system would occur (Criterion B).**

Sand placement on the beach and in the nearshore is anticipated to result in a wider beach at Cardiff State Beach on a temporary basis. No new coastal structures would be constructed as part of Alternative 1B, and the addition of sand would temporarily provide additional protection to existing coastal structures, such as businesses along Coast Highway 101, including Restaurant Row. The existing inlet would be improved, but remain in place, and no changes to wave refraction or inundation by tsunami or seiche would occur within the lagoon. **Temporary beneficial impacts would result with respect to risks of damage to coastal structures (Criterion C).**

#### *Alternative 1A*

Alternative 1A would result in an ebb bar with a volume of approximately 3,900 cy at equilibrium, increased from the existing 3,600 cy. The flood bar would remain substantially larger than the volume of the ebb bar (78,000 cy if there is no inlet maintenance, but approximately 33,000 cy if maintained annually) under Alternative 1A, and the inlet would remain flood dominated, as it is under existing conditions. Accretion of sand within the ebb bar is anticipated to be less than 150 cy within the first year. While this amount of sand may be stored within the nearshore as opposed to the beach, it would not be considered a substantial reduction of sand on the beach, and would be more than offset with the first annual maintenance effort to clear out the lagoon, which anticipates placing up to 25,000 cy on the beach. Therefore, the small increase in nearshore storage needs in the ebb bar would be accommodated the first year through the onshore placement of material at Cardiff State Beach as part of inlet maintenance. Effects to beach erosion would be less than significant. Lagoon maintenance activities and placement of that material downcoast would effectively return that sand to the

littoral zone. **This bypassing would offset the effects of sand storage in the flood bar and no substantial adverse or significant impact would result to beach erosion downcoast (Criterion A).**

No sand placement within the nearshore would occur under Alternative 1A, and the bathymetry of the bottom would not be changed substantially by the small increase in ebb bar storage to modify wave patterns, water currents, or sand transport patterns. Therefore, no anticipated changes to littoral processes are anticipated from this alternative. **No substantial adverse or significant impacts would occur (Criterion B).**

No sand placement would occur on the beach as part of Alternative 1A construction, and no new coastal structures would be constructed. Existing coastal structures, such as businesses along Coast Highway 101, including Restaurant Row, would not receive additional short-term protection from damage. The existing inlet would be improved but remain in place, and no changes to wave refraction or inundation by tsunami or seiche would occur within the lagoon. **No substantial adverse or significant impacts would result with respect to risks of damage to coastal structures and no benefit would be received (Criterion C).**

#### ***No Project/No Federal Action Alternative***

The No Project/No Federal Action Alternative would not change the existing estimated ebb bar volume of approximately 3,600 cy at equilibrium. The flood bar would remain substantially larger than the volume of the ebb bar (63,400 cy if there is no inlet maintenance, but approximately 25,000 cy if maintained annually), and the inlet would remain flood-dominated, as it is under existing conditions. No changes to existing inlet maintenance are anticipated, and annual maintenance of the lagoon inlet is expected to continue to bypass sand by placing approximately 30,000 cy of material on Cardiff State Beach. **There would be no effect on beach conditions and no substantial adverse or significant impacts to beach erosion at the lagoon or downcoast would occur (Criterion A).**

No sand placement within the nearshore would occur under the No Project/No Federal Action Alternative, and the bathymetry of the sea bottom would not be changed. There would be no anticipated changes to littoral processes from the No Project/No Federal Action Alternative, and **no substantial adverse or significant impacts to the littoral system would occur (Criterion B).**

No sand placement or construction of new coastal structures would occur as part of the No Project/No Federal Action Alternative. Existing coastal structures, such as businesses along Coast Highway 101, including Restaurant Row, would not experience additional risks, nor would

they obtain beneficial protection from damage. The existing inlet would remain and no changes to wave refraction or inundation by tsunami or seiche would occur. **No substantial adverse or significant impacts would result with respect to risks of damage to coastal structures (Criterion C).**

#### **Materials Disposal/Reuse**

##### ***Alternative 2A–Proposed Project***

##### Offshore Stockpiling

Sand would be placed within the offshore stockpile areas SO-5 and/or SO-6 (previously dredged areas from the SANDAG RBSPs implemented in 2001 and 2012). The stockpiled material would make minor changes to the bathymetry in these previously borrowed areas. Because SO-5 and SO-6 would be located outside of the closure depth they are, by definition, outside of the zone of substantial wave energy impinging on the seabed. As a result, waves would pass over the seabed unattenuated by the moderate bathymetric changes made by sand placement and no substantial changes to wave patterns, currents, or sand transport would occur. SO-5 and SO-6 are located outside of the littoral zone and do not have substantial sand exchange with beaches within the littoral zone. **No substantial adverse impacts would occur to existing littoral processes, including the rate of erosion on beaches within the littoral zone. Impacts would not be substantially adverse and would be less than significant (Criteria A and B).**

Materials placement at offshore sites would occur entirely under water and would not involve the construction of new coastal structures. Changes to littoral processes, waves and currents, or inundation characteristics are not anticipated; therefore, **risks of damage to coastal structures would not be substantially adverse and would be less than significant (Criterion C).**

##### Nearshore

Nearshore placement adjacent to Cardiff State Beach is a critical component of the proposed project. This material would pre-nourish the ebb bar to minimize sand erosion on adjacent beaches and is discussed under the lagoon restoration analysis. As analyzed under the lagoon restoration analysis, **no substantial adverse impacts to littoral processes, sand erosion rates, and risk of damage to coastal structures would occur, and impacts would remain less than significant (Criteria A, B, and C).**

## Onshore

Materials placement of sand on beaches would temporarily increase widths in the vicinity of placement sites, and sand would then be expected to redistribute as it is influenced by both longshore and cross-shore transport patterns. Predicted changes in shoreline position are shown in Table 3.3-1.

**Table 3.3-1**  
**Predicted Changes to Existing Shoreline with Beach Sand Placement**

Receiver Site (at widest point in the middle of the fill footprint)	Constructed Beach Width (feet)	Post-Project Beach Widths <sup>1</sup> (in feet)				
		1 Year	2 Years	3 Years	4 Years	5 Years
Leucadia Beach	200	18–15 <sup>2</sup>	11	11	11	11
Moonlight Beach	180	38–32	20–18	17–16	16–14	15–14
Cardiff Beach <sup>3</sup>	150	35–31	13–12	0–1	13–9	28–27
Solana Beach	70	24–21	15–14	14	14–13	12–10
Torrey Pines Beach	160	41–36	24–22	20–18	17–15	16–14

Notes:

1. GENESIS modeling results predicting general areas of accretion or erosion rather than site-specific increments of shoreline movement over time.
2. Modeling conducted for both calm and high wave conditions to provide a range of potential erosion/accretion trends. Numbers above reflect predictions for calm wave and high wave conditions, respectively.
3. After 3 years, the disposal/reuse material at Cardiff Beach would be negligible. But maintenance dredging would occur so the beach width increases in Year 4. Maintenance would occur approximately every 3 years so material would be replaced about the same time as it would fully accrete.

Several trends are predicted by the modeling of sand movement. Beach fill placement sites would be discernibly larger after nourishment at each placement site. As time passes, exaggerated bulges at beach placement sites would gradually become less pronounced and appear to extend laterally along the coast. As the fill disperses laterally alongshore, beaches between the fill sites would become wider. As a result, several beaches that are not placement sites may experience long-term widening. This condition is anticipated to occur particularly between sites that are in proximity. Sand is predicted to remain evident in the system for at least 5 years (the definition of “long-term” widening) at multiple locations throughout the North County region.

The SELRP would widen beaches at sand placement sites and certain adjacent beaches for up to 5 years. This widening would add material to the littoral system but would not change transport patterns or erosion rates of sand on those beaches. As noted in Table 3.3-1, beach width at Cardiff is predicted to decrease to preexisting conditions 3 to 4 years after initial implementation of the SELRP. Then, the scheduled maintenance dredging would occur and up to 300,000 cy

would be placed at that location. Beach width would increase again resulting in more consistent beach width in that location, which otherwise tends to erode. **Beach sand erosion that could result in long-term beach loss would not occur, and no substantial adverse impacts would occur. Impacts would be less than significant (Criterion A).**

Once it is placed, material would migrate cross-shore as well as along the shore, and sometimes accumulate in the nearshore as additional sand volume or sand bars. This accumulation may affect localized wave characteristics temporarily (e.g., surfing) but would not change the underlying littoral processes that drive sand transport, including regional wave patterns and currents. **No substantial adverse or significant impacts to the littoral system would occur (Criterion B).**

No new permanent coastal structures would be constructed as part of materials placement on area beaches, and the addition of sand would temporarily provide additional protection to existing coastal structures on the beach, as well as bluffs that support coastal structures. **Beneficial impacts would result with respect to risks of damage to coastal structures (Criterion C).**

No direct impacts to the three proximate coastal lagoons would occur from the project. Sand placed from the project has the potential to be transported up and down the coast, then entrained within lagoon inlets. Depending on the volume of material transported, this could lead to more frequent inlet closures and declines in lagoon conditions. Ongoing maintenance programs are implemented at the three subject coastal lagoons to remove excess sediment if it results in inlet closure.

Potential sedimentation to adjacent lagoons due to the project has been predicted based on the method used for the 2012 RBSP (SANDAG 2011); specifically,

- Assumptions of the existing rate of sand capture by the lagoon (portion of the existing gross longshore sediment transport rate),
- Quantity of sand volume placed at a site within the vicinity of the lagoon by the SELRP, and
- Net sand transport direction from that site.

It should be noted that the quantity in the second bulleted item above represents the maximum possible placement of material at each disposal/reuse site, and actual volumes could be less depending on the ultimate configuration of the disposal/reuse scenario. The placement of less material at specific sites would result in a corresponding decrease in sedimentation at lagoon inlets; therefore, the analysis represents a worst-case evaluation.



The SELRP proposes a similar set of materials placement sites and volumes as the 2001 and 2012 RBSPs, with certain exceptions (no fills at Del Mar or anywhere north of Leucadia Beach, and slightly less material at Moonlight Beach). Therefore, conditions experienced at lagoon mouths in proximity to those sites after the 2001 RBSP was constructed could represent trends of the potential effects of the SELRP. Comparison to this prior project in terms of sand volumes and past impact to that lagoon provides a “test-based” perspective for consideration, in combination with the model predictions.

Table 3.3-2 identifies predicted contributions of sand through littoral transport to Batiquitos, San Dieguito, and Los Peñasquitos lagoons and an overview of past history based on the 2001 RBSP. **The modeling indicates there would be no significant or substantial adverse impact to these lagoons from placement of SELRP material at onshore sites near these three lagoons (Criterion D).** Reviewing the history from the 2001 RBSP suggests the model predictions are valid.

#### ***Alternative 1B***

Results for Alternative 1B would be similar to Alternative 2A, but slightly decreased (by 200,000 cy overall, from 1.2 mcy for Alternative 1B to 1.4 mcy for Alternative 2A) for a worst-case scenario. The same offshore, nearshore, and onshore material placement sites are identified for both alternatives, although Alternative 1B would place 200,000 cy less material in the nearshore off Cardiff State Beach. Because the placement scenarios are so similar in nature, and no substantial adverse or significant impacts were identified for Alternative 2A, **Alternative 1B is anticipated to also result in less than significant impacts to long-term beach loss, littoral system processes, risks to damage to coastal structures, and coastal wetlands (Criteria A, B, C, and D). No substantial adverse impacts would be anticipated.**

#### ***Alternative 1A***

As part of Alternative 1A, no sand would be placed within the littoral zone as part of materials disposal/reuse. No changes to SO-5 or SO-6, or the littoral zone would occur.

#### **LA-5**

Under Alternative 1A, the only location for off-site materials disposal/reuse would involve disposal of material in LA-5, located outside of the littoral zone approximately 6 miles offshore in relatively deep water. Materials placement within this site would not affect the littoral system, and therefore long-term beach loss, or increase risks of damage to coastal structures. **No substantial adverse or significant impacts would occur to long-term beach loss, littoral**

**Table 3.3-2**  
**Potential Sediment Contribution to Lagoons and Comparison to the 2001 RBSP Observations**

<b>Coastal Lagoon</b>	<b>SELRP Beach Fill Volumes (cy)</b>	<b>Predicted Effects from SELRP over 6 Years</b>	<b>Impact Conclusion for SELRP<sup>1</sup></b>	<b>2001 RBSP Beach Fill Volumes at Receiver Sites (cy)</b>	<b>Measurable Effects from 2001 RBSP</b>
Batiquitos	150,000 at Moonlight and 117,000 at Leucadia = 267,000	Minor sedimentation estimated at 9,100 cy total	<b>No substantial adverse or significant impact</b>	South Carlsbad 158,000 Batiquitos 118,000 Leucadia 132,000 Moonlight 105,000 = 513,000 total	None
San Dieguito	150,000 at Solana Beach	Minor sedimentation estimated at 4,200 cy total	<b>No substantial adverse or significant impact</b>	Solana Beach 146,000 Del Mar 183,000 =329,000 total	Closures increased due to effects from beach fill at the Del Mar receiver site (CFC 2010b)
Los Peñasquitos	245,000 at Torrey Pines	Minor sedimentation estimated at 10,200 cy total	<b>No substantial adverse or significant impact</b>	245,000 at Torrey Pines Del Mar 183,000 =428,000 total	Indiscernible, although Los Peñasquitos Lagoon Foundation indicates Del Mar fill was observable (Hastings 2010)

<sup>1</sup> Significance Determination for Criterion D  
cy = cubic yards

**system processes, risks to damage to coastal structures, or coastal wetlands due to Alternative 1A (Criteria A, B, C, and D).**

***No Project/No Federal Action Alternative***

Under the No Project/No Federal Action Alternative, no material would be removed from San Elijo Lagoon or require disposal. Therefore, **no substantial adverse or significant impacts to beach erosion or long-term beach loss, the littoral system, risks of damage to coastal structures, or coastal wetlands would occur (Criteria A, B, C, and D).**

**3.3.4 AVOIDANCE, MINIMIZATION, AND MITIGATION MEASURES**

No substantial adverse or significant impacts have been identified; therefore, no mitigation measures are required.

**3.3.5 LEVEL OF IMPACT AFTER MITIGATION**

CEQA: No significant impacts have been identified for coastal processes due to implementation of the SELRP.

NEPA: No substantial adverse impacts would occur to coastal processes due to implementation of the SELRP.

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